REMARKS

In the present Office Action, claims 1-14 were examined. Claims 1-14 are rejected and no claims are allowed. By this Amendment, claims 1 and 9 have been amended, claims 15-20 have been canceled, and no new claims have been added. Accordingly, claims 1-14 are presented for further examination. No new matter has been added. By this Amendment, claims 1-14 are believed to be in condition for allowance.

Claims 1-8 were rejected under 35 U.S.C. §102(b) as being anticipated by Chen et al. (U.S. Patent No. 5,800,930). Applicants respectfully traverse this rejection. Chen et al., which is commonly owned with the present application, discloses a chemical treatment for copper foil which imparts a dark brown to black color to the foil. The treatment includes depositing a nodular copper/nickel alloy layer on a surface of the foil. Chen et al. discloses that one advantage of this treatment is that the dark treatment is readily removed in conventional chemical etching solutions. (See column 2, lines 19-21).

In contrast, amended claim 1 is directed to a copper foil for lamination to a dielectric substrate, having a laser ablation inhibiting layer coating on the copper foil. The laser ablation inhibiting layer of the present invention has an average surface roughness of between 0.4 micron and 0.7 micron which provides the laser inhibiting layer with a lamination peel strength of at least 4.5 pounds per inch. The laser ablation inhibiting layer is deposited as a nodular structure with an average nodule height of less than 0.75 micron. (See Applicants' specification at page 10, lines 325-326). As stated in the present specification, it is believed that the lower surface profile as compared to commercial thin copper foil products enhances stopping of the laser at a back side of the second copper foil layer during laser drilling. (See Applicants' specification at page 10, lines 327-329). In addition to its inhibiting effects, the laser ablation inhibiting layer imparts a suitable peel strength to prevent delamination of the copper foil by its surface roughness. (Applicants' specification at page 10, lines 329-331).

In contrast to the claimed invention, enhancement of laser ablation can be accomplished by forming a dark oxide layer on the surface of the copper foil that is opposite the dielectric. Such a dark oxide layer is disclosed in the present specification at page 11, lines 341-343.

Nowhere in its disclosure does Chen et al. teach or suggest the copper foil of the present invention. Specifically, Chen et al. discloses plating copper foil with copper/nickel nodules and then coating the copper foil with a layer of chromium/zinc antitarnish coating. Chen et al. discloses a nodular copper/nickel electrodeposited layer having a dark color. The nodular height is disclosed to be in the range of 0.5 micron to 3 micron. However, contrary to the Applicants' disclosed treatment, the treatment disclosed in Chen et al. enhances laser ablation rather than inhibits it. Enhancement of laser ablation by the utilization of a dark oxide coating is generally known in the art and is discussed in the present specification at page 11, line 342. More particularly, enhancement of laser ablation by the utilization of a dark coating is discussed in "High-Volume Microvia Formation Using CO_2 and UV Diode-Pumped Solid-State Lasers," by Sri Venkat, page 4, 2001 (copy enclosed herein) which states "CO_2 lasers, however, cannot form microvias through the bare copper foil layers of MLB laminates since this material reflects almost all of the laser radiation and absorbs very little. To work around this limitation, separate processes must be included that either selectively etch the copper away or increase its absorption by blackening the areas to be removed by oxide treatment." Accordingly, the use of a black or dark coating to enhance laser ablation is known in the art.

In view of the Chen et al. disclosure of a dark color layer and the recognition that this dark color layer enhances laser ablation, the Chen et al. reference does not teach or suggest the presently claimed copper foil which inhibits laser ablation. In fact, Chen et al. teaches away from the presently claimed invention as it discloses a treatment that enhances ablation rather than a treatment that inhibits ablation.

The average nodule height of less than 0.75 micron in amended claim 1 overlaps a portion of the disclosed average nodule height in Chen et al. However, 90% of Chen et al.'s range is larger than 0.75 micron. Additionally, Chen et al. disclose using a dark color coating to enhance laser ablation. This is in distinct contrast to the present invention which demonstrates a copper foil having a laser ablation inhibiting layer with increased peel strength utilizing nodules having a small average height (i.e. less than 0.75 micron). Since Chen et al.

disclose larger nodules and a dark coating, which increases peel strength but enhances laser ablation, claims 1-8 should be allowed over Chen et al.

Claims 1-14 were rejected under 35 U.S.C. §103(a) as being unpatentable over Chen et al. in view of Yamanishi et al. or Ameen et al. or Poutasse III et al. None of the cited references taken alone or in combination, teach or suggest forming a laser ablation inhibiting layer on a copper foil. Accordingly, the Applicants respectfully traverse this rejection.

Chen et al. has been discussed above. Yamanishi et al. discloses a copper foil having a roughened side and a shiny side. The foil is coated with a coating layer having a mixture of zinc and zinc oxide, chromium oxide and nickel, and either or both of zinc and zinc oxide at least on the shiny side of the foil. Yamanishi et al. does not disclose or suggest that this coating has an average surface roughness of between 0.4 micron and 0.7 micron for a suitable peel strength to prevent delamination of the foil as disclosed in Applicants' specification at page 10, lines 330-331. Additionally, Yamanishi et al. does not disclose or suggest a layer that provides laser ablation inhibition which has a suitable peel strength of at least 4.5 pounds per inch and has nodules with an average height of less than 0.75 micron.

Ameen, et al. discloses a treated copper foil coated with a layer of zinc oxide followed by a layer of a chromium oxide that is adhered to the zinc oxide layer. Ameen et al. further discloses an optional layer of a silane coupling agent adhered to the layer of chromium oxide.

While Ameen et al. discloses a layer of zinc oxide and a further layer of chromium oxide on copper foil, Ameen et al. does not disclose or suggest the presently claimed laser ablation inhibiting layer that can be a codeposited mixture of chromium and zinc and their oxides. Additionally, Ameen et al. does not disclose or suggest that the zinc oxide layer and chromium oxide layer have an average surface roughness of 0.4 micron to 0.7 micron. Ameen et al. does not disclose or even suggest a suitable lamination peel strength as is recited in the presently claimed invention. Accordingly, Ameen et al. does not disclose or suggest the presently claimed invention.

Poutasse III, et al. discloses a copper foil with a duplex silane layer as an adhesion promoting layer. The adhesion promoting layer enhances adhesion between the foil and another substrate. As noted by the Examiner, the Poutasse III et al. reference discloses the

silane adhesion promoting layer has a peel strength of greater than 4.5 pounds per inch (see Example 3). The silane adhesion promoting layer of Poutasse III et al. does not suggest the laser ablation inhibiting layer of the present invention since the laser ablation inhibiting layer additionally has an average surface roughness between 0.4 micron and 0.7 micron. While Poutasse III et al. discloses surface roughening may occur to a copper foil, it does not teach or suggest a laser ablation inhibiting layer having an average surface roughness of between 0.4 micron and 0.7 micron that has a lamination peel strength of at least 4.5 pounds per inch. In fact, Poutasse III, et al. disclose "it is a significant advantage of the invention that desired adhesive characteristics for the foil can be achieved without subjecting the foil to an added surface roughening treatment." (Col: 4, lines 21-25). Thus, Poutasse III, et al. actually teach away from the presently claimed invention.

The Examiner contends that the presently claimed invention is obvious over Chen et al. in view of Yamanishi et al, Ameen et al. and Poutasse III, et al. However, for the reasons presented above, Applicants respectfully disagree that the references, either alone or in combination, teach or suggest the presently claimed invention. Accordingly, claims 1-14 are allowable over the cited prior art.

Accordingly, Applicant submits that none of the references, alone or in combination, anticipate or make obvious the invention as presently claimed and that the application is now in condition for allowance. It is respectfully submitted that the proposed amendments do not necessitate additional search by the Examiner and that they should be properly entered under the provisions of 37 C.F.R. 1.116. Applicants believe that with this amendment all claims are now in condition for allowance, or in the alternative in better condition for appeal. If the Examiner considers that an additional amendment is required to place the application in condition for allowance, he is invited to contact Applicants' attorney at the telephone number listed below.

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Respectfully submitted,
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Date: June 24, 2005
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